Preliminary Note on the Change of Personal Equation with Stellar Magnitude in Transits observed with the Transit Circle at the Royal Observatory, Greenwich. By W. H. M. Christie, M.A., F.R.S., Astronomer Royal.

The question of the determination of the variation of personal equation with the magnitude of the star observed has been lately brought prominently forward by Professor Auwers in connection with the Greenwich observations of *Victoria* and *Sappho* and comparison stars in 1889, now being discussed by him. I had hoped to have used the Personal Equation Machine for this investigation, this being one of the objects for which it was originally intended, but as special photometric arrangements would have to be devised, it was judged best, in order to avoid delay, to determine the change of personal equation in observations of stars with the transit circle, when screens of fine wire gauze were placed in front of the object-glass to obscure the stars' light. The screens used were marked *a*, *b*, *e*, *f*, and *g*, the first three being made of fine brass wire, and the last two of coarser iron wire. The size of the meshes, which are approximately square, and the thickness of the wires, were measured with a micrometer microscope for each of these screens, and the results are given in the following table.

	Screen *a*.	*b*.	*e*.	*f*.	*g*.
	mm.	mm.	mm.	mm.	mm.
Side of squares of mesh ...	0·45	0·52	0·39	1·08	1·21
Thickness of wire ...	0·12	0·13	0·13	0·34	0·30

As the star entered the field of the telescope, the object-glass was covered successively by one or other of these screens, or by two screens superposed, the observer then making estimations of the apparent magnitude of the stars, whose light was thus diminished. The accuracy of these estimations was tested by the comparison of the magnitude given in the Greenwich Ten-Year Catalogue, or in the British Association Catalogue, with similar estimations of magnitude, either (1) with the object-glass unscreened, when the estimated magnitude should agree with the tabular, or (2) when card diaphragms, with circular apertures of $5\frac{1}{8}$ and $3\frac{1}{4}$ inches diameter respectively, were placed over the object-glass, so that the estimated magnitudes should differ by 1·0 and 2·0 magnitudes respectively from the tabular. The mean results of these estimations for each observer, and for each screen, diaphragm, or pair of screens, are given in Table I. It will be seen from the estimations with full aperture, and with diaphragms *c* and *d*, that all the observers agree in estimating the magnitude as numerically too large, and that

this excess is larger the smaller the apparent star is. We may say from this that the screens *a*, *b*, and *e* each diminish the brightness by between 1·5 and 2·0 magnitudes.

As a star approached the transit wires, the object-glass was covered with a screen, and the transit recorded over the first four wires; the screen was then removed, and the transit over the last four wires was recorded with full aperture of object-glass. For the next star the order of these operations was reversed, that is, the first four wires were observed with full aperture, and the last four with the screen. The excess of the time of transit, reduced to centre wire, with screened object-glass over the time with unscreened, was then tabulated. The means of the results of these observations for each observer, and for each screen or pair of screens, are given in Table II. Since it appears from Table I. that the values of screens *a*, *b*, and *e* are approximately the same, as are also those of *f* and *g*, the observations by each observer with screens *a*, *b*, and *e*, with *f* and *g*, and with the pairs $\overline{a+b}$, $\overline{a+e}$, $\overline{b+e}$ have been taken together, and then grouped according to the magnitudes of the stars observed. The results of this grouping are given in Table III. As far as they go they indicate that there is a general tendency with all the observers to observe stars with object-glass screened later, and that this is more marked in the case of the fainter stars. It will be remarked that the general mean, when the brightness is reduced nearly four magnitudes by means of two screens, is less than the general mean when only one screen is used, instead of being nearly double, as it should be theoretically. The comparative paucity of observations with two screens superposed may, to some extent, account for this anomalous result, but it is not unlikely that the observers may have been influenced by the peculiar character of the diffraction image equally with one screen and with two. It is not clear that the results indicate a real change of personal equation in observations of fainter stars, as the introduction of the screen modifies the image of the star, and this modification of the image may give rise to a change of personal equation unconnected with the diminution of brightness.

TABLE I.

Table of Difference of Estimated and Tabular Magnitudes by each Observer when the Star is seen with full aperture and with each diaphragm and each screen.

	No. of Obs.	A.D. Mag.	No. of Obs.	T. Mag.	No. of Obs.	L. Mag.	No. of Obs.	H. Mag.	Means Mag.
Full aperture	89	+0·20	67	+0·37	103	+0·08	157	+0·05	+0·14
Screen a	65	+2·46	40	+2·15	93	+1·76	97	+2·00	+2·05
Screen b	59	+2·15	44	+2·00	88	+1·51	97	+1·79	+1·81
Screen e	51	+2·68	43	+2·16	93	+1·98	75	+2·11	+2·18
Screen f	23	+1·91	7	+1·24	7	+1·43	16	+1·49	+1·63
Screen g	20	+1·86	8	+1·23	7	+1·14	18	+1·52	+1·55
Screen $\overline{a+b}$	18	+3·99	24	+3·80	27	+3·28	23	+3·73	+3·66
Screen $\overline{a+e}$	8	+4·20	21	+3·75	25	+3·67	6	+4·32	+3·83
Screen $\overline{b+e}$	4	+3·78	20	+3·80	26	+3·44	6	+3·65	+3·62
Diaphragm c $3\frac{1}{4}$ inches...	53	+2·56	36	+2·33	80	+1·88	85	+2·07	+2·15
Diaphragm d $5\frac{1}{8}$ inches...	61	+1·54	39	+1·74	87	+1·17	94	+1·21	+1·34

TABLE II.

Excess of Observed Time of Transit with Screen over Observed Time with Full Aperture.

Observer.	Screen *a*. No. of Obs.	Screen *a*.	Screen *b*. No. of Obs.	Screen *b*.	Screen *e*. No. of Obs.	Screen *e*.	Screen $\overline{a+b}$. No. of Obs.	Screen $\overline{a+b}$.	Screen $\overline{a+e}$. No. of Obs.	Screen $\overline{a+e}$.
		s		s		s		s		s
A.D.	27	+0·027	26	+0·020	20	+0·016	5	+0·030	1	+0·050
T.	11	+0·034	9	+0·036	12	+0·062	7	+0·057	6	+0·007
L.	20	+0·026	23	+0·013	13	+0·053			3	−0·040
H.	38	+0·036	41	+0·036	24	+0·028	5	+0·064	2	−0·005
Means		+0·031		+0·026		+0·035		+0·051		−0·003

Observer.	Screens $\overline{b+e}$. No. of Obs.	Screens $\overline{b+e}$.	Screens $\overline{a+b+e}$. No. of Obs.	Screens $\overline{a+b+e}$.	Screen *f*. No. of Obs.	Screen *f*.	Screen *g*. No. of Obs.	Screen *g*.
		s		s		s		s
A.D.	3	−0·013	1	+0·020	7	0·000	4	+0·023
T.	4	+0·048	2	+0·050			2	−0·040
L.	2	−0·060			1	0·000		
H.					7	+0·004	5	+0·056
Means		+0·004		+0·040		+0·002		+0·027

TABLE III.

Excess of Observed Time of Transit with Screen over Observed Time with Full Aperture arranged according to Magnitude of Star.

Screen *a*, *b*, or *e* diminishing the brightness by nearly 2 magnitudes.

Magnitude of Stars.	A.D. No. of Obs.	A.D. Mean Diff.	T. No. of Obs.	T. Mean Diff.	L. No. of Obs.	L. Mean Diff.	H. No. of Obs.	H. Mean Diff.
		s		s		s		s
0–3·9	14	+0·036	5	+0·022	11	−0·007	6	+0·015
4·0–4·9	13	+0·022	8	+0·016	10	+0·035	9	+0·034
5·0–5·9	22	+0·014	13	+0·064	30	+0·039	25	+0·023
6·0–6·9	14	+0·013	4	+0·067	4	+0·008	38	+0·033
7·0 and fainter	8	+0·051	1	+0·070	1	+0·020	24	+0·052
Means	71	+0·024	31	+0·045	56	+0·025	102	+0·034

General Mean $+0^s{\cdot}031$.

Screens $\overline{a+b}$, $\overline{a+e}$, or $\overline{b+e}$ diminishing the brightness by about 3·7 magnitudes.

Magnitude of Stars.	A.D. No. of Obs.	A.D. Mean Diff.	T. No. of Obs.	T. Mean Diff.	L. No. of Obs.	L. Mean Diff.	H. No. of Obs.	H. Mean Diff.
		s		s		s		s
0–3·9	6	−0·023	5	+0·036	2	−0·045	2	−0·005
4·0–4·9	3	+0·100	5	+0·064	3	−0·050	3	+0·030
5·0 and fainter			7	+0·022			2	+0·115
Means	9	+0·018	17	+0·038	5	−0·048	7	+0·044

General Mean $+0^s{\cdot}023$.

The Motion of 20 Draconis. By S. W. Burnham.

Although this double star (Σ 2118) was discovered by William Herschel more than one hundred years ago, it has received but little attention from observers in recent years. Within the last thirty years it has been close and rather difficult, but before 1860 it was easily measurable with almost any telescope. During this period the distance was slowly diminishing, while the angle remained nearly constant. For the past ten years it has been too close to be seen with any but the most powerful refractors.

I have collected all the observations with the micrometer which have any value, and give them below in chronological order for convenience in future investigations. I have omitted all negative results where the star was noted as "round," "single," "elongated," &c., since it is evident that it has never been really single, and the failures to see it were due to insufficient optical power, or unfavourable atmospheric conditions.

1783·26	251°·5	...	H	1*n*
1830·32	242·6	0·63	H	1*n*
1831·37	246·1	0·70	H	1*n*
1832·30	246·4	0·85	Σ	5*n*
1834·57	252·0	...	Da	1*n*
1836·75	247·0	0·71	Σ	3*n*
1840·77	242·9	...	Da	1*n*
1841·24	245·3	0·77	OΣ	3*n*
1843·32	248·4	0·8	Ma	1*n*
1847·71	243·3	...	Mh	2*n*
1847·97	244·6	0·65	Ma	2*n*
1854·81	241·7	0·61	Da	3*n*
1857·35	240·1	0·37	Se	3*n*
1859·67	235·7	0·58	OΣ	2*n*
1872·42	238·0	0·27	OΣ	1*n*
1874·73	224·0	...	N	1*n*
1877·13	229·4	0·28	De	3*n*
1880·82	211·3	0·20	β	4*n*
1889·45	140·7	0·11	β	3*n*
1891·33	125·6	0·11	β	3*n*

All of these measures are laid down accurately to scale on the accompanying diagram, except the observations of Herschel, Dawes, Mitchell, and Newcomb, where the distance was not measured. It is obvious at a glance that these positions taken together furnish no evidence whatever of orbital motion so far